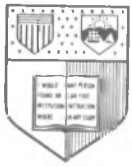
Cornell University

ANNOUNCEMENTS

Graduate School of Medical Sciences



1966-67

Cornell University

Graduate School of Medical Sciences

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1300 York Avenue
New York, New York 10021
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Contents

Calendar*

FALL SEMESTER	1966-67
Registration	Sept. 9 & 12
Opening Exercises, 3:30 p.m.	Sept. 12
Instruction begins for first trimester and fall semester	Sept. 13
Thanksgiving Day, Holiday	Nov. 24
End of first trimester	Nov. 26
Examinations for first trimester	Nov. 28-Dec. 3
Instruction begins for second trimester	Dec. 5
Christmas recess: Instruction ends, 1:00 p.m.	Dec. 17
Instruction resumes at 9:00 a.m.	Jan. 3
Last day for completing all requirements for February degrees	Jan. 13
Fall semester ends	Feb. 1

SPRING SEMESTER	
Registration	Feb. 2 & 3
Instruction begins for spring semester	Feb. 6
End of second trimester	Mar. 4
Language examinations	*(To be announced)*
Examinations for second trimester	Mar. 6-18
Instruction begins for third trimester	Mar. 20
Spring recess: Instruction ends, 1:00 p.m.	Apr. 15
Instruction resumes at 9:00 a.m.	Apr. 24
Last day for completing all requirements for June degrees	May 26
Memorial Day, holiday	May 30
Commencement, 3:30 p.m.	June 7
End of third trimester and spring semester	June 10
Examinations for third trimester	June 12-14

SUMMER	
Summer research period begins	June 7
Registration for summer research	June 7
Last day for completing all requirements for September degrees	Sept. 1
Labor Day, holiday	Sept. 5
Summer Research period ends	Sept. 8

* Courses in the Graduate School of Medical Sciences are either semestral or trimestral. The calendar for this School is based primarily on the academic semester but is coordinated as well with the trimestral calendar of the Medical College.

GRADUATE SCHOOL OF MEDICAL SCIENCES

OFFICERS OF ADMINISTRATION

James A. Perkins, A.B., Ph.D., *President of Cornell University.*
W. Donald Cooke, B.S., M.S., Ph.D., *Dean of the Graduate School of Cornell University.*
John E. Deitrick, B.S., M.D., *Associate Dean of the Graduate School of Medical Sciences.*
Julian R. Rachele, B.A., M.S., Ph.D., *Assistant Dean of the Graduate School of Medical Sciences.*

THE COMMITTEE OF THE GRADUATE SCHOOL OF MEDICAL SCIENCES

Julian R. Rachele, *Chairman*

Dorothea Bennett
Liebe F. Cavalieri
C. Chester Stock
John Y. Sugg

FACULTY

Professors

Norman T. J. Bailey, D.Sc., Professor of Biomathematics, Graduate School of Medical Sciences.
M. Earl Balis, B.A., M.S., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.
Aaron Bendich, B.S., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.
Oscar Bodansky, A.B., M.A., Ph.D., M.D., Professor of Biochemistry, Sloan-Kettering Division.
George B. Brown, B.S., M.S., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.
Liebe F. Cavalieri, B.S., M.S., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.
Hirsh G. Cohen, Ph.D., Visiting Professor of Biomathematics, Graduate School of Medical Sciences.
Gilbert Dalldorf, B.S., M.D., D.Sci., Professor of Pathology, Emeritus, Sloan-Kettering Division.
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Frank W. Foote, Jr., B.A., M.D., Professor of Pathology, Sloan-Kettering Division.
Jack J. Fox, B.A., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.
Gerhard H. Giebisch, M.D., Professor of Physiology and Biophysics, Cornell University Medical College.

Roger L. Greif, B.S., M.D., Professor of Physiology and Biophysics, Cornell University Medical College.

Joseph C. Hinsey, B.S., M.S., Ph.D., Sc.D., Professor of Neuroanatomy, Cornell University Medical College; Consultant, New York Hospital-Cornell Medical Center.

Frank L. Horsfall, Jr., B.A., M.D., C.M., F.D. (h.c.), LL.D., D.Sc., Professor of Medicine, Cornell University Medical College; Professor of Microbiology, Sloan-Kettering Division; President and Director, Sloan-Kettering Institute, and Director, Sloan-Kettering Division.

John G. Kidd, B.A., M.D., Professor of Pathology, Cornell University Medical College.

Edwin D. Kilbourne, B.A., M.D., Professor of Public Health, Cornell University Medical College.

John S. Laughlin, A.B., M.S., Ph.D., Professor of Biophysics, Sloan-Kettering Division.

Walsh McDermott, B.A., M.D., Livingston Farrand Professor of Public Health, Cornell University Medical College.

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Associate Professors

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Cornell University

GRADUATE SCHOOL OF MEDICAL SCIENCES

PURPOSE AND NATURE OF GRADUATE STUDY

The Graduate School of Medical Sciences of Cornell University offers facilities for advanced study and research for students desiring a comprehensive view of a field of knowledge and training for investigation in that field. The faculty of the School requires of all candidates for advanced degrees a period of study in residence, advanced competence in some one subject, and adequate introduction to allied subjects, as well as the passing of language, qualifying, and final examinations, the latter including presentation and defense of a satisfactory thesis.

The Graduate School of Medical Sciences offers work leading to the degree of Doctor of Philosophy in the basic science fields of anatomy, biochemistry, biology, biomathematics, biophysics, immunology, microbiology, pathology, physiology, preventive medicine, and virology, and to the Master of Science degree in certain of these fields. Cornell University has a strong commitment to doctoral work, and the philosophy of the Graduate School of Medical Sciences is consonant with that of Cornell in this matter. The School does, however, recognize the need and a place for the Master's degree in certain fields.

The degree of Doctor of Philosophy is granted not only as a result of the fulfillment of certain technical requirements such as residence study or satisfactory completion of graduate courses, but it bespeaks as well the development and possession of a critical and creative ability in science and of a fruitful expression of the imagination. Evidence of the latter is given in the disserta-

tion that the candidate prepares and which constitutes an original research contribution to the field of knowledge chosen for study.

GRADUATE SCHOOL HISTORY

Graduate work leading to an advanced general degree has continued to occupy a place in the Medical College since 1912 when it was offered in a cooperative arrangement with the Graduate School of Cornell University. Under the plan as originally announced, students registered for an advanced degree in the Medical College, but in all respects they were subject to the rules and regulations prevailing at the University. The departments offering graduate instruction were identified in the first announcement as the "scientific departments."

In June, 1950, the trustees of Cornell University entered into an agreement with the Sloan-Kettering Institute for Cancer Research whereby a new division of the Medical College, namely, the Sloan-Kettering Division, was created for the purpose of offering additional opportunities for graduate study toward advanced degrees, thus extending the areas of the basic sciences. This expansion of the New York City component of the Graduate School prompted the faculty of the University's Graduate School to give consideration to matters of administration, with the result that by action of the trustees in January, 1952, the Graduate School of Medical Sciences was established, which, with the approval of the Graduate School faculty of Cornell University, "shall have full responsibility for advanced and professional degrees granted for study in residence at the New York City campus of Cornell University."

FACILITIES

The Medical College

The buildings of the Medical College extending along York Avenue from 68th to 70th Streets contain the main library, the lecture rooms and student laboratories for the basic science departments, and the extensive research facilities for staff and students in the areas of anatomy, biochemistry, microbiology, pathology, pharmacology, and physiology.

The Sloan-Kettering Division

The facilities of the Sloan-Kettering Division consist of the Howard Laboratory and the Kettering Laboratory on East 68th Street in New York City, and the Walker Laboratory in Rye,

New York. Collectively, these facilities represent the Sloan-Kettering Institute for Cancer Research. The special facilities and staff of experienced investigators of the Sloan-Kettering Division provide ample opportunities for advanced training in biochemistry, biology, and biophysics.

ORGANIZATION OF THE SCHOOL

The Deans

The Dean of the Medical College, who holds the additional title of Associate Dean of the Graduate School of Medical Sciences, is the administrative head. He reports annually to the Graduate School faculty of Cornell University for approval of the activities of the Graduate School of Medical Sciences.

The Assistant Dean of the Graduate School of Medical Sciences aids the Associate Dean in the fulfillment of his responsibilities.

The Faculty

The Faculty includes the professors, associate professors, and assistant professors in the basic science or preclinical fields in all departments of the Medical College and in the Sloan-Kettering Division, who have available a reasonable amount of their time for scholarly work and graduate training and who recognize a special responsibility toward graduate students. Some instructors and research associates holding the degree of Ph.D., who are needed to fulfill the special responsibilities of a Field, are eligible for inclusion in the faculty and may act as representatives for minor subjects on Special Committees of graduate students.

The Committee of the School

The Committee of the Graduate School of Medical Sciences is both an administrative and judicial board. The Committee considers matters referred to it by the faculty or by members of the faculty and may on its own initiative make recommendations to the faculty on any matters concerning the interests or policies of the Graduate School of Medical Sciences.

The Assistant Dean serves as chairman of this Committee with four members of the Graduate faculty. Two members of the Committee represent the faculty of the Sloan-Kettering Division and the remaining two members are chosen from the faculty in the basic science fields of the Medical College. The faculty members of the Committee are nominated by the Associate Dean and appointed annually by the President of the University.

The Committee serves as an agency for: (1) approval and administration of the admission of students, (2) approval of major and minor subjects, (3) allotment of units of credit toward advanced degrees, (4) selection of members of the faculty to conduct and make recommendations in the fulfillment of the language requirements, and (5) student discipline.

ADMISSION

For admission to the Graduate School of Medical Sciences, an applicant (1) must have a baccalaureate degree or the equivalent from a college or university of recognized standing, (2) must have adequate preparation in the chosen field of instruction, and (3) as judged by his previous record, must show promise of ability to pursue advanced study and research.

Applicants may be admitted in September, February, or July. All credentials must be submitted at least three months prior to planned admission.

Application for admission is to be made on special forms obtainable from the Office of the Graduate School of Medical Sciences, Cornell University Medical College, 1300 York Avenue, New York, N.Y. 10021. The completed application is to be returned to the School. The applicant is required to support his application for admission with two letters of recommendation from individuals in academic pursuits who know the applicant personally, and with official transcripts of record from all the colleges and universities attended by the applicant. The applicant must arrange to have the supporting credentials forwarded to the Office of the Graduate School of Medical Sciences.

Before formal application is submitted, it may be advisable for a prospective applicant to confer, either in person or by writing, with a member of the faculty in a major discipline in either the Medical College or the Sloan-Kettering Division, in order to obtain the faculty member's consent to sponsor and plan his program. In consultation with other faculty members who teach in the student's minor Fields, the sponsor organizes and acts as chairman of the faculty group, the student's Special Committee.

When application for admission is made without prior consultation with a member of the faculty, the student who is accepted will be assigned a temporary major sponsor.

Scores made in the Graduate Record Examination, although not required, will prove helpful in determining the acceptability of the applicant. Students who plan to take this examination should communicate directly with the Educational Testing Service, Princeton, New Jersey 08540.

Proficiency tests to examine the student's background in any or all of the basic sciences presented as preparation for the fields constituting any candidate's major and minor subjects may be required at the discretion of the candidate's major sponsor. The tests are given a few days before initial registration. Each test will cover material normally presented in undergraduate courses in those sciences. The results of these tests will be used to aid the candidate's Special Committee in planning his course of study. While the results of these tests will not be considered in the usual sense of "passing" or "failing," low marks in one or more of the tests may require a preponderance of elementary courses.

A student is admitted to the Graduate School when a formal notice of acceptance has been issued by the Associate Dean of the Graduate School of Medical Sciences. If the candidate is accepted with conditions, these will be recorded in the notice of admission.

Provisional Candidacy

Under circumstances in which it is difficult to evaluate the academic background of qualified applicants, they may be admitted to *provisional* candidacy. Such status is often appropriate to the foreign student. Ordinarily only one semester of study in provisional candidacy is permitted, and the student who fails to qualify for candidacy at the end of that time may be requested to withdraw from the Graduate School of Medical Sciences. In any event, no more than two semesters of study in provisional candidacy are permitted, and of these no more than one may be considered as applicable to the residence requirement for a degree.

Non-Candidacy

When staff and facilities are available, the Graduate School will admit some applicants who do not intend to work toward an advanced degree at Cornell but who have special objectives for formal study or scholarly work at the graduate level. In order to be admitted for study in non-candidacy, the applicant must satisfy all the entrance requirements expected of degree candidates. Registration in non-candidacy is restricted to two semesters.

Change of Status

A student who wishes to change his status from non-degree candidacy to regular candidacy or from one degree or field to

another, or who, after receiving the Master's degree, wishes to undertake candidacy for the doctorate, must submit a written request to the Office of the Graduate School of Medical Sciences asking for transfer to the new status, and giving reasons for the requested change. Provisional candidacy is automatically reviewed at the end of each semester, and no letter is necessary.

REGISTRATION

All students must register in the Office of the Graduate School of Medical Sciences at the beginning of the fall and spring semesters and the summer research period. It is expected that students who matriculate will continue for the full academic year (commencing in September and terminating with the end of the summer research period). Should circumstances require attendance for less than a year, special arrangements may be made for registering for one semester. A graduate student who has completed the residence requirements for his degree and who remains in residence while working on his thesis or while doing other work in preparation for a degree must register each semester in which he is so engaged.

A graduate student who discontinues his work during a semester in which he is registered should immediately report this fact to the Office of the Graduate School of Medical Sciences in order to obtain an official withdrawal or an honorable dismissal.

MAJOR AND MINOR SUBJECTS

The curriculum of a candidate for the degree of M.S. consists of a major and one minor subject; of a candidate for the degree of Ph.D., a major and two minor subjects. Approved subjects are listed below as separate fields of instruction. A candidate is urged to select minor subjects which do not fall in the same general field of instruction as his major.

SPECIAL COMMITTEES

Special Committees are the means for directing individual candidates in the attainment of that independence implicit in advanced degrees. While a candidate is choosing his major and minor subjects, he selects, with approval of the Associate Dean, eligible members of the faculty to represent each subject and to serve as his Special Committee. The representative of the major subject is Chairman. The Chairman prepares reports on grades in formal courses and performance in research and makes requests for qualifying and final examinations. Any faculty member is eligible to

serve on these committees, but the Chairman must be of professorial rank. An instructor may serve on a Special Committee as representative for a minor subject.

The members selected indicate their willingness to serve by signing the record of major and minor subjects, which is filed with the Office of the Graduate School of Medical Sciences.

Members of the Special Committee instruct or supervise the instruction of a candidate, judge whether the student's progress is satisfactory, conduct qualifying and final examinations, and approve the thesis. Although they are the candidate's advisers, it is the responsibility of the candidate himself to become familiar with the various regulations that apply to his case and to satisfy them in the proper way.

There are no regulations of the Graduate faculty on the content of instruction or courses to which the Special Committee must subscribe. The Special Committee may impose any requirements that it deems necessary over and above the general requirements.

RESIDENCE REQUIREMENTS

The faculty requires of each candidate for a Master's degree a minimum of two residence units. Candidates for a Master's degree who receive fellowships must complete all requirements for the degree within two years of initial registration. For the doctorate, a minimum of six residence units is required. One residence unit represents one academic semester of full-time study or research toward the doctoral thesis.

No residence unit or fraction is granted in fulfillment of the requirements for the Master's degree for study outside the Graduate School. In the case of a Ph.D. candidate, no commitment will be made for acceptance of previous study in another graduate school in lieu of required residence until after the candidate has entered into study in residence in the Graduate School. Then the residence units will be determined by the Committee on the basis of a transcript of record and other credentials, but may not exceed those that would be earned under similar circumstances at Cornell University; and passing courses or acquiring credit hours is not regarded as evidence satisfactory in itself for transfer of credit. Under any circumstances, the residence credits transferred for graduate work in another school will be limited to a maximum of two units. Study as a candidate or as a special student in an undergraduate college is not acceptable, even though the courses may be designed for graduate students.

Graduate students who participate in teaching or assist in research work do not qualify for full residence credit although

their duties usually will lie in the field of their major interest. In general, a student who gives time to a related service, not to exceed six hours a week, is eligible for full credit. If his other duties require 20 hours a week, the earned credit ordinarily will not exceed ¾ of a unit each semester. By earning an additional ½ unit in summer research, he may earn two full units in a calendar year. But as a rule, the Committee will not permit anyone to receive credit for more than two units in any period of twelve consecutive months. Eligibility to receive residence units and fractions of units is determined by the Committee of the Graduate School of Medical Sciences.

Graduate students in the Graduate School of Medical Sciences may undertake formal studies or may conduct research on the Ithaca campus. By prior arrangement, such a student registers in the Graduate School at Ithaca and works under an adviser resident at Ithaca who may be appointed as an optional member of the student's Special Committee. This same privilege is available to graduate students from the Ithaca campus who find it desirable to conduct studies at the Graduate School of Medical Sciences.

A candidate for the degree of Ph.D. must complete two of the last four units in successive terms of study at the Graduate School of Medical Sciences or at the Ithaca campus, as noted above.

Each candidate for an advanced degree is expected to complete his study in residence with reasonable continuity. A candidate who fails to register during any period of four or more years is dropped from candidacy and may be readmitted only after the Committee of the Graduate School of Medical Sciences has stipulated the amount of additional residence to be required. No more than ten years may intervene between the time of first registration and the completion of all requirements for a doctorate degree.

LANGUAGE REQUIREMENTS

A candidate for the degree of Ph.D. must demonstrate proficiency in two foreign languages, other than his native language, chosen from the following four: French, German, Russian, English. A candidate may petition to substitute other languages for French, German, or Russian. Foreign students may, with permission of the Committee of the Graduate School, count their native language, except English, as one of the two required foreign languages. Specific reasons must be offered for the proposed substitutions, e.g., that the language is needed in conducting research for the candidate's thesis. Candidates who receive permission to substitute another language for either French, German,

or Russian shall be required to take a written examination in that language at a specified time under an examiner appointed by the Office of the Graduate School of Medical Sciences.

For the M.S. degree proficiency in either French, German, or Russian will fulfill the requirement. Failure to pass the language examination may require the candidate to complete three units of residence credits for the degree. The student will be expected to demonstrate proficiency before beginning the third residence unit.

Students planning graduate study leading to an M.S. or Ph.D. degree must demonstrate proficiency in one language within the first year following acceptance. With permission of the Committee of the School, a candidate may satisfy this requirement by a language test passed at another graduate school in fulfillment of requirements for an advanced degree. Language requirements for the Ph.D. degree must be completed satisfactorily before a student begins work for his last two residence units.

To demonstrate proficiency, the candidate is required to pass a general examination. The examination will consist of passages from the biological or physical sciences designed to test the student's ability to translate a representative piece of prose. The examination will be graded "pass" or "fail" on the basis of whether the student has demonstrated sufficient speed and accuracy to make language a useful instrument for reasearch. The use of a dictionary is allowed. A vocabulary test may be required in addition to the above general examination.

EXAMINATIONS

For the doctoral degree: A Qualifying Examination and a Final Examination are required for the Ph.D. degree.

(1) The Qualifying Examination serves to determine the candidate's fitness to undertake advanced studies and to enable the Special Committee to plan a program which will provide the candidate with the requisite knowledge and techniques for pursuing research work toward the doctoral thesis. An early date for this examination is considered essential. The Qualifying Examination, therefore, must be taken during the first two semesters of residence. The candidate will be examined on fundamental aspects in the areas of the sciences which are considered germane to his major and minor subjects. The examination is written and oral. The written examination should be given no more than one week prior to the oral examination. A copy of the questions used in the written examination and the grades for this examination are to be submitted to the Office of the Graduate School before the Special Committee administers the oral examination. The major sponsor may select any members of the faculty to assist the

Special Committee in the evaluation of the Qualifying Examination.

(2) The Final Examination must be taken in two parts: (a) Examination A, which is oral and written, covers the subject matter of the major and minor fields. Examination A is to be given not earlier than the last month of the fourth unit of residence and at least four months before the second part, Examination B; (b) Examination B is oral and is designed to constitute a defense of the candidate's thesis. Decision that a candidate has passed or failed his final examinations rests solely with the members of the candidate's Special Committee; however, any member of the faculty of the Graduate School of Medical Sciences is privileged to attend the oral examinations and to take part in questioning the candidate. Members of the faculty attending the examinations are at liberty to inform the Associate Dean in writing that they disagree with the judgment of the Special Committee and may request review by the Committee of the Graduate School of Medical Sciences of the case in question.

For the Master's degree: A Final Examination is required for the M.S. degree. This examination covers the candidate's major and minor subjects and is oral and written.

GRADES

Graduate students taking courses in the Graduate School of Medical Sciences must register for each course and take the final examination or have the office records marked "incomplete." Courses may be audited with the permission of the department head, but no credit will be given.

Credit for graduate work is given only when the candidate does well in both his major and minor fields of study. Professors having charge of the work of graduate students are required to report to the Office of the Graduate School of Medical Sciences at the end of each semester, or at the close of each academic year, grade ratings on all students taking work under their direction. These grade reports are given in the following terms: A (93-100), B (84-92), C (75-83), and F for work unacceptable for credit. Students whose average grade falls below a B may be dropped.

THESES

Research accomplishment presented in the form of a thesis is a principal requirement for both the M.S. and Ph.D. degrees.

Students enrolled for the Master's degree are required to pre-

pare a report on some problem or project undertaken in their major field. In content and form this report must show scholarly attainment.

A candidate for the degree of M.S. or Ph.D. must submit an outline and early draft of the thesis to all members of the Special Committee *at least six weeks* before the Final Examination unless this requirement is modified by the Special Committee.

At least fifteen days before the Final Examination, the candidate shall submit to the Office of the Graduate School of Medical Sciences the typewritten original and one copy (carbon or other approved reproduction) of the thesis, both unbound, and two copies of an abstract of the doctoral thesis of not more than 600 words. The candidate shall also provide each member of the Special Committee with a typed copy of the thesis which the Committee members may retain until the time of the examination.

The thesis submitted to the Special Committee at least fifteen days before the Final Examination may be modified as a result of the Final Examination, but at the time of the examination, it must be complete in all respects and editorially acceptable for final approval. Subsequent to the examination the final copies of the thesis, with the signed Thesis Approval form and copies of the endorsed abstract of a doctoral thesis, must be deposited at the Graduate Office on or before the last day for completing requirements and not more than sixty days after the Final Examination.

Doctoral theses must show ability to do critical and independent investigation, must be a contribution to knowledge, and must be presented in a scholarly fashion. They should reflect not only a mastery of a field of research, but the ability to select an important problem for investigation and to deal with it competently. A date for the final examination will be set only after the chairman of the student's Special Committee gives written notice to the Office of the Graduate School of Medical Sciences that the thesis is approved.

The facilities of the University Microfilms, Ann Arbor, Michigan, are used to provide for publication of the thesis on microfilm and for the publication of the abstract of the dissertation in the monthly publication entitled *Dissertation Abstracts.*

A copy of the rules and requirements for the submission and the preparation of the thesis may be obtained from the Office of the Graduate School of Medical Sciences. The two copies of the thesis submitted to this office will be bound and deposited in the Medical College Library and in the department where the thesis work was done.

EXPENSES

The fee for the Graduate School of Medical Sciences for the academic year is $1800. This is an inclusive fee with $1514 of the amount apportioned for tuition and the remainder for all accessory items; namely, matriculation, student hospitalization insurance, laboratory charges, graduation fee, microfilming of the doctoral thesis, publishing the abstract in the monthly periodical, *Dissertation Abstracts,* mailing the thesis and abstract to and from the microfilm publishers, binding two copies of the thesis, and the tuition fee.

Graduate students who have completed the minimum residence requirements and have paid the tuition fees for their degrees may complete their theses in residence and take the final examinations by registering as candidates for degree only. No additional tuition payment will be required, but a registration fee of $286 per academic year will be charged to cover hospitalization insurance, etc.

Tuition or other fees may be changed by the Board of Trustees at any time without previous notice.

FINANCIAL ASSISTANCE

Predoctoral fellowships are available to qualified applicants. The fellowships may be renewed yearly providing the academic performance of the fellowship holders is satisfactory. Teaching and research assistantships are available to qualified graduate students in some departments of the Medical College. In addition to a stipend, the costs of tuition and other fees are defrayed for those students receiving financial assistance.

The applicant may obtain information on the available fellowships and assistantships by writing directly to the Chairman of the department of his proposed major Field, Cornell University Medical College, 1300 York Avenue, New York, N.Y. 10021, or to the Associate Director of the Sloan-Kettering Division, 425 East 68th Street, New York, N.Y. 10021.

Other predoctoral fellowships are available on a national basis from the National Science Foundation, the National Research Council, and the National Institutes of Health. Information on these fellowships should be requested directly from the appropriate government agency. The Graduate School of Medical Sciences will provide the granting agency with the necessary credentials to support the fellowship application of applicants who qualify for admission to the School.

RESIDENCE HALLS

The Medical College offers accommodations in limited number of single and married graduate students. F. W. Olin Hall, student residence. is located at 445 East 69th Street, directly across York Avenue from the Medical College entrance. It contains a gymnasium, snack bar, lounge rooms, and 278 residence rooms. Each residence room is furnished as a single bedroom-study, but, since each two rooms have a connecting bath, they may be used as a suite for two students if desired. The rooms are completely furnished, and linen service is provided. Rental for students is: for an academic year, $425; for a full year (12 months), $485. One floor is reserved for women students, and non-housekeeping facilities for married students are available. Several cafeterias are available in the main college and hospital buildings.

Livingston Farrand Apartments for married students, a newly remodeled elevator building at 427 East 69th Street, next to Olin Hall, provides nineteen 1½-room apartments and nineteen three-room apartments; all apartments are furnished. Rentals for the 1½-room apartments are $75 to $85 per month and for the three-room, $115 to $125 per month.

Two adjacent buildings newly remodeled in 1960 are also available for married students. The building at 425 East 69th Street provides twenty two-room apartments, with rentals ranging from $70 to $77 per month; all are furnished. The building at 423 East 69th Street provides a total of sixteen two-, three-, and four-room apartments; all are furnished. Rentals range from $70 to $77.50 per month for two-room apartments; from $110 to $120 per month for three-room apartments; and from $130 to $137.50 for four-room apartments.

STUDENT HEALTH SERVICE

Complete ambulatory medical care is provided for all students matriculated in the Graduate School of Medical Sciences through the Personnel Health Service of the Medical Center. Students matriculating for the first time in the Graduate School are required to have a physical examination by a member of the Health Service staff. In addition each student must report for a chest X-ray examination, tuberculin test, and such immunizations as may be considered necessary at periodic intervals. No charge is made for medical care through the Health Service or for any X-rays, laboratory tests, or procedures which may be needed. Each student is required to carry Associated Hospital Service (Blue Cross) hospitalization insurance unless some similar hospitalization insurance is currently in effect through a previous policy.

The cost of this insurance for an unmarried student is included in the "Expense" fee. Wives and dependents of students may be covered by the hospitalization insurance policy for a small additional fee. Office hours are held Monday through Friday from 12:30 to 1:30 p.m. by the Student Health staff. All cases of illness must be reported to the Health Service. Students may have in attendance physicians of their own choice, but a reasonable amount of cooperation between such physicians and the College Health Service is expected. Wives and families of students are not eligible for care through the Personnel Health Service but will be referred to appropriate members of the hospital staff for medical care.

SUMMARY OF REGULATIONS FOR GRADUATE STUDENTS

A student contemplating admission to graduate work leading to the M.S. or Ph.D. degree must first obtain the approval of his program from a member of the faculty. If encouraged by the faculty member to proceed, the student may file his application.

When registered for one of these degrees, the candidate should observe carefully the following requirements:

For the Master's Degree

He must -

1. Complete a minimum of two units of work in residence, including a major and one minor course of study.
2. Demonstrate proficiency in one foreign language.
3. Pass a final examination covering his general field of study.
4. Present a thesis approved by the professor representing his major field of study and the Committee of the Graduate School of Medical Sciences.
5. Submit two typewritten copies of the thesis, one for filing in the Medical College Library and the other for the department representing his major field of study.

For the Ph.D. Degree

He must -

1. Complete six units of training in residence, of which two units of the last four must be taken in successive terms at the Medical College or the Sloan-Kettering Division.
2. Demonstrate proficiency in two languages approved by the Committee of the Graduate School of Medical Sciences.

3. Achieve a high level of scholarly capacity (grade of B or better) and demonstrate the ability and technique necessary for carrying on original work.

4. Complete the following examinations: (1) a qualifying examination during the first year of residence, and (2) the final examinations.

5. Present a thesis in the major field of study, which must represent a contribution to the subject investigated.

6. Prepare an abstract of the approved thesis for publication in *Dissertation Abstracts.*

7. Submit two unbound typewritten copies of the thesis at least 15 days before examination B, one for filing in the Medical College Library and the other for the department representing the major field of study.

RESEARCH SOCIETIES

Sigma Xi, a national honorary society devoted to the encouragement of scientific research, was founded at Cornell University at Ithaca in 1886. An active branch of the Cornell Chapter is maintained at the Medical College. Graduate students are eligible for election to membership in Sigma Xi on the basis of proved ability to carry on original research and on nomination by active members of the Cornell Chapter. Graduate students elected to the society prior to enrolling at Cornell are invited to become active members of the local chapter.

The Cornell University Medical Research Society will hold meetings weekly on Tuesdays, throughout the academic year, beginning October 4. This informal society offers faculty members of all divisions of the Center an opportunity to present papers dealing with original research. Graduate students are invited to attend the meetings and to submit papers for possible presentation.

FIELDS OF INSTRUCTION

The several fields of instruction of the Graduate School of Medical Sciences are described in the pages that follow. The title of each field is an approved major or minor subject for candidates for advanced degrees.

INSTRUCTION AT THE MEDICAL COLLEGE

Anatomy

Chairman: Professor Roy C. Swan.

Professors: Roy C. Swan, Joseph C. Hinsey (Neuroanatomy).
Associate Professors: Dorothea Bennett, Dana C. Brooks, James L. German III, Wilbur D. Hagamen, John MacLeod, Thomas H. Meikle, Jr., Leonard L. Ross, Julio L. Sirlin.
Assistant Professors: Saul Bader, Michael D. Gershon, Elsa O'Donnell-Alvelda, Muriel Sackler, Richard G. Skalko, Benjamin D. Stinson.
Instructor: Chen Ya Huang.

Facilities are available for graduate study in various areas of the broad subject of anatomy; in histology, cytology, electron microscopy, neuroanatomy, experimental neurology, male fertility, embryology, and genetics. Students desiring to pursue graduate work in anatomy must have had adequate preliminary training at college level in physics, chemistry, and biology. The specific course requirements for either a major or a minor in anatomy will be determined for each candidate after consultation with the authorized representatives of the other departments involved.

COURSES OFFERED

1. GENETICS SEMINAR. Organized on the basis of 4 semesters covering in sequence: nucleic acids and genetic fine structure (fall semester, 1966); cytogenetics; differentiation and gene action in higher organisms; genetics of man and medical genetics. Prerequisites: 6 hours of undergraduate genetics and permission of the instructors.

2. CYTOLOGY. A presentation of cell fine structure by lectures, demonstrations, and individual projects. Special emphasis will be placed on the methods of analysis, including light and electron microscopy, cell fractionation, and autoradiography.

3. DEVELOPMENTAL BIOLOGY. A graduate course emphasizing fundamental problems of development in embryonic and postembryonic systems and the level of current understanding as revealed by application of modern analytical methods. Two lectures a week for eleven weeks during the third trimester; optional independent laboratory projects restricted to a limited number of students. Prerequisite: an undergraduate course in embryology, or the course, Developmental Anatomy and Genetics, required of first-year medical students at Cornell. Admission by permission of the instructor.

Biochemistry

Chairman: Professor Vincent du Vigneaud.

Professors: Vincent du Vigneaud, Julian R. Rachele.
Associate Professors: Roy W. Bonsnes, William D. Cash, Aaron S. Posner.
Assistant Professors: Esther M. Breslow, Wah-Yip Chan, Helena Gilder, Julius Golubow, S. Steven Hotta, Theodore A. Mahowald, Edward T. Schubert.
Instructors: Robert T. Havran, Victor J. Hruby, John D. Termine.

Opportunity is offered candidates for the Ph.D. degree to work in various areas of biochemical investigation such as enzymology, intermediary metabolism, physical chemistry and structure of proteins and other macromolecules, and synthesis of compounds of biological importance.

Graduate students in the Department of Biochemistry may avail themselves of the full facilities of the department for their thesis research work. These facilities include modern instrumentation for all aspects of chromatography, countercurrent distribution, radioactive and stable isotope methodology, spectrophotometry, and ultracentrifugation.

Graduate students with biochemistry as their major Field or those who elect biochemistry as a minor are to register for the course General Biochemistry (the regular Medical College course) and are expected to attend the lectures and conference sessions of this course which is given over the entire academic year. In the place of the laboratory part of the course General Biochemistry, majors and minors in biochemistry are to include the graduate course Experimental Biochemistry in their programs.

The lectures and conferences in the course General Biochemistry constitute a prerequisite or a concurrent requisite for any part of the lecture course Advanced Graduate Biochemistry, which is given over a period of five consecutive trimesters. It is desirable that this course be included in the study program of candidates for the Ph.D. degree in biochemistry.

Graduate students expecting to pursue investigations in biochemistry should have adequate training in inorganic, organic, analytical, and physical chemistry. In addition, a background of courses in general physics and in mathematics through differential and integral calculus is considered essential. A general course in biology is strongly recommended. A deficiency in any of these areas must be made up with appropriate courses at the beginning of graduate study. Furthermore, while the Graduate Record Examination is not generally required of applicants, those applicants who are not within the top third of their graduating class are urged strongly to support their applications with scores attained on the Graduate Record Examination in both the Aptitude Test (Verbal and Quantitative) and the Advanced Test in Chemistry.

COURSES OFFERED

1. GENERAL BIOCHEMISTRY. This course is given as part of the

regular Medical College curriculum. The lectures and conference sessions deal with the following topics: the chemistry and the intermediary metabolism of proteins, carbohydrates, and lipids, and nucleic acids; protein biosynthesis and genetic coding; enzymes, enzyme kinetics and inhibition; hormones; vitamins; mineral metabolism; the structure and composition of tissues, blood, milk, urine, and other body fluids; the elements of physical chemistry, as applied to biology and medicine, with emphasis on the properties of electrolytes and macromolecules. First and second trimesters, 1-2 p.m. on Monday, Thursday, and Friday. Third trimester, 9-10 a.m. on Monday, Wednesday, and Friday.

2. EXPERIMENTAL BIOCHEMISTRY. This laboratory course is designed to provide the student with practical experience in the techniques concerned with the isolation, characterization, analysis, and handling of biologically important compounds. The course includes experiments on the ionic properties and equilibria of ampholytes, the amino acid composition and the sequence of amino acids in peptides, the isolation of enzymes and their purification and assay, the isolation and characterization of metabolic intermediates, the isolation of nucleic acids and their characterization, the study of the incorporation of labeled precursors into cellular and tissue constituents, etc. Second trimester, all day Tuesday and 1-5 p.m. Wednesday.

3. ADVANCED GRADUATE BIOCHEMISTRY. The course and the hours when it is given are described below under Interdepartmental Courses.

4. ADVANCED LABORATORY RESEARCH. The degree candidate registers for this course for the first time at the onset of experimental work for his thesis project and then continues to register for this course until completion of the laboratory work concerned with his dissertation. The hours are by special arrangement with the major sponsor.

5. BIOCHEMICAL LITERATURE. Seminars on the current literature in biochemistry are required of majors in the Department of Biochemistry and are open to minors in the Field of Biochemistry. Hours to be arranged.

Microbiology

Chairman: Professor William F. Scherer.

Professors: William F. Scherer, John Y. Sugg.
Associate Professors: Leonhard Korngold, William M. O'Leary.
Assistant Professors: Robert W. Dickerman, Elena Ottolenghi, Dieter H. Sussdorf.

Candidates for the Ph.D. degree and postdoctoral fellows can select an area of research interest and activity from such microbiological fields as general and medical bacteriology, microbial chemistry and physiology, microbial genetics, immunology, mycology, and virology.

Prospective students should complete in undergraduate school a minimum of one year - or its equivalent - in general chemistry, organic chemistry, general physics, mathematics including college algebra, botany or zoology (preferably both), and one semester or its equivalent of analyti-

cal or quantitative chemistry. General microbiology or bacteriology and calculus are strongly recommended. Students who have not completed the above requirements may be admitted to graduate study on the condition that deficiencies be removed soon after admission.

Courses in graduate work are determined by the student's Special Committee made up of faculty representing his major and minor subjects. Included for Ph.D. candidates in microbiology are the following courses: medical microbiology, microbial chemistry and physiology, advanced immunology, advanced virology, microbial genetics, microbiology seminar, biochemistry, and biostatistics.

The nature and number of other courses depend on the student's minor subjects, his research activities, his individual interests, and the advice of his Special Committee. Such courses at this institution or at near-by universities are available in anatomy, biophysics, cell biology, histology, mycology, parasitology, pathology, pharmacology, physiology, and radiobiology.

COURSES OFFERED

Graduate courses are given during the eleven-week period corresponding to the third trimester of the Medical College curriculum. Lectures are open to all interested persons. Laboratory sessions are generally limited to students taking the course for credit.

1. MICROBIAL CHEMISTRY AND PHYSIOLOGY. Yearly. Two lectures and two laboratory periods weekly. Lectures cover literature and methodology pertinent to physicochemical properties of microorganisms and their environments, the growth and death of microorganisms, chemical composition of cells and subcellular structures, nutritional requirements, microbiological assay and auxotrophic mutants, energy metabolism, degradations and biosyntheses, the physiology of pathogenesis, and important microbial products. Laboratory sessions provide experience with large-scale culture and recovery of cells, synthetic media, microbiological assay, extraction of cellular constituents, respirometry, and studies of substrate utilization employing radioactive metabolites. Minimum prerequisites for credit are general microbiology, qualitative and quantitative analysis, organic chemistry, and at least one semester (or its equivalent) of biochemistry.

2. ADVANCED IMMUNOLOGY. Every second or third year. Two lectures and two laboratory periods weekly. Lectures emphasize current concepts regarding antigen and antibody structure, the physical and biological manifestations of antigen-antibody reactions, and recent developments in studies on the cellular basis of immunity, including antibody formation. The laboratory will cover the isolation, purification, and quantification of antibodies; the critical measurement of antigen-antibody reactions; histological mechanisms during the immune process; and *in-vivo* effects of specific antigen-antibody reactions. Minimum prerequisites for credit are introductory immunology (as given in courses in general microbiology) and at least one semester (or its equivalent) of biochemistry. A semester course in histology or microscopic anatomy is desirable.

3. ADVANCED VIROLOGY. Every second or third year. This course presents, in lectures and laboratory sessions, modern concepts and

technics of virology. Virus structure, chemical composition, physical and biologic properties, and relationships with host cells are considered in depth. Minimum prerequisites for credit are general microbiology and at least one semester (or its equivalent) of biochemistry.

4. MICROBIAL GENETICS. Every second or third year. Two lectures and two laboratory sessions weekly. The lectures deal with genetic systems in fungi, bacteria, and bacterial viruses. Emphasis is placed on those basic concepts of genetics which have been elucidated by the study of microbial systems. Laboratory experiments are designed to demonstrate some of the mechanisms of genetic recombination among microorganisms. Minimum prerequisites for credit are general microbiology and at least one semester (or its equivalent) of biochemistry. A course in general genetics is desirable but not required.

5. MICROBIOLOGY SEMINAR. Scheduled biweekly. Topics in microbiology and infectious diseases are presented in depth by faculty and graduate students of the Department of Microbiology and by visiting scientists from other institutions.

Pathology

Acting Chairman: Professor A. Whitley Branwood.

Professors: John G. Kidd, Robert C. Mellors.

Associate Professors: A. Whitley Branwood, Aaron Kellner, George E. Murphy, Goetz W. Richter, John F. Seybolt, Jean E. Todd, Richard M. Torack.

Assistant Professors: Carl G. Becker, Jack W. C. Hagstrom, William D. Johnson, James S. Magidson, C. Richard Minick, William W. Schlaepfer.

Instructors: Sin Hang Lee, Andrew H. Littell, Carolyn W. Watson.

The department offers a wide opportunity for the experimental study of disease. Adequate animal facilities are available. Most of the current journals and reference books are kept in the departmental library. Autopsies for the entire hospital are performed by members of the department, and this material, together with specimens in the laboratories of surgical pathology and cytology, offers opportunities for the study of many problems of disease.

Study at the graduate level is oriented toward scientific training in experimental pathology, and special emphasis is placed on a basic training in the fundamental aspects of pathology. By contact with individual staff members instruction and training is given in immunopathology; neuropathology; basic cellular pathology including electron microscopy, cyto- and histochemistry, cell fractionation and biochemical and biophysical methods; fundamental experimentation with laboratory animals in the study of disease; and gross and microscopic pathology of human tissues and organs.

Candidates will be required to take the second-year course offered to medical students as an initial part of their program. The latter part of the graduate's training will be devoted to research in an area of the candidate's choice under the guidance of a senior staff member.

A candidate can qualify for the Ph.D. degree by majoring in experi-

mental pathology. Graduates who do not possess the M.D. degree must have an adequate knowledge of biology, chemistry, mathematics, and physics. The necessary preparation in anatomy, biochemistry, physiology, and biometrics may be obtained at the Medical College as part of the graduate program.

COURSES OFFERED

1. GENERAL AND SYSTEMATIC PATHOLOGY. Lectures, practical classes and seminars, first and second trimester.

2. NEUROPATHOLOGY. Lectures, practical classes and seminars, third trimester.

Prerequisites for the above courses are as in the general description.

Pharmacology

Chairman: Professor Walter F. Riker, Jr.

Professor: Walter F. Riker, Jr.
Associate Professors: Jack Peter Green, Walter Modell, Frank G. Standaert.
Assistant Professors: Amir Askari, William T. Beaver, Wah-Yip Chan, Roberto Levi, Barrie Levitt.
Instructors: Michiko Okamoto, Arthur Raines.

Facilities are available for advanced work and research in the chemical, pharmacodynamic, and clinical aspects of pharmacology. Special opportunities are afforded for work in general pharmacology, neuropharmacology, cardiovascular pharmacology, biochemical pharmacology, and drug evaluation in man. The department is well equipped with specialized apparatus for electrophysiological and biochemical techniques.

In graduate training, emphasis is placed on a sound basic training in general pharmacology. By means of individual instruction, the candidate is later afforded an exposure to several specialized aspects of pharmacology. The latter part of the graduate curriculum is devoted to research in an area of the candidate's choice.

An adequate preliminary training in organic chemistry, physical chemistry, biochemistry, and physiology is prerequisite for graduate work in pharmacology. A training in statistics is strongly recommended.

COURSES OFFERED

1. GENERAL PHARMACOLOGY. The basic pharmacology course as offered to second-year medical students is open to graduate students. The course consists of lectures, laboratory work, demonstrations, and seminars given during the first and second trimesters. The purpose of these exercises is to teach the principles of pharmacology. Detailed consideration is given to the parameters of drug action so as to provide the student with the fundamental concepts essential for the evaluation of any drug. Consequently, emphasis is placed on the scientific basis of pharmacology. Prototype drugs, considered essentially systemically, serve to illustrate several mechanisms and parameters of drug action. Therapeutic applications are considered only insofar as they illustrate princi-

ples of pharmacology or drug hazards. 154 hours. Prerequisites: biochemistry and physiology.

2. INTRODUCTION TO CHEMICAL BIOLOGY. A survey of some physicochemical and biochemical aspects of the interactions of drugs with living systems will be presented in weekly lectures of two hours each during the second semester of the academic year. The following subjects will be presented: (1) *The nature of drug-biophase interaction* includes a discussion of the properties of drugs as electrolytes, the binding of drugs by polyelectrolytes and other substances, the passage of drugs from the aqueous phase into the cell, and the effects of drugs on the properties of the interface between the aqueous and biophase. (2) *The kinetics of the drug-biophase interaction* includes a review of chemical kinetics, the application of chemical kinetics to the reactions of drugs with living systems, and an evaluation of receptor theory. (3) *The relationships between chemical structure and biological activity* are presented with special emphasis on those steric and electronic properties of biologically active substances that provide inferential evidence of the structure and configuration of the biological locus of action, e.g., the receptor enzyme. (4) *The modification of cell metabolism by drugs* describes the metabolic effects of selected drugs and critically analyzes the relationship between their metabolic and pharmacologic effects. (5) *The modification of drugs by cell matabolism* embraces all mechanisms of biotransformation and discusses the relevance of drug metabolism to pharmacological action. Prerequisites: physical chemistry, organic chemistry, biochemistry, and pharmacology.

3. PHYSIOLOGY AND PHARMACOLOGY OF NEURONAL TISSUE. Offered in the third trimester. In a series of two one-hour sessions per week, consideration will be given to the following: (a) the functional properties of certain nerve cells and their processes; (b) the alteration of these properties by drugs; (c) events associated with transmission of excitation and inhibition between neurones and at neuroeffector junctions; (d) drug effects on transmission processes; (e) chemical transmission, especially as concerns the physiology and pharmacology of adrenergic nerves; (f) trophic influences of nerve; (g) functions of peripheral sensory nerve endings and the influence of drugs thereon. Prerequisites: physiology and pharmacology.

4. RESEARCH IN PHARMACOLOGY. Research opportunities through arrangement are available throughout the year for graduate students who are not majoring in pharmacology but who wish some investigative experience in the discipline. Special opportunities are offered for work on the nervous and cardiovascular systems and in biochemical aspects of pharmacology.

Physiology and Biophysics

Chairman: Professor Robert F. Pitts.

Professors: Robert F. Pitts, Gerhard H. Giebisch, Roger L. Greif.
Associate Professors: Harold G. Hempling, Richard H. Kessler, Erich E. Windhager.
Assistant Professors: Sulamita Balagura, Colin Fell, Lou Ann Pilkington.

Opportunities are offered for graduate study toward a Ph.D. degree and for postdoctoral research training in limited areas of physiology and biophysics, including the physiology of the circulatory system, endocrine organs, and kidney, and the biophysics of membrane transport. The laboratory is well equipped for both chemical and physical studies on living animals. The staff has special competence in areas of acid-base regulation; the renal tubular transport of ions employing micropuncture techniques; the transport of ions, water, and organic metabolites in uniform cell populations; the mode of action of thyroid hormones; the metabolism of the kidney; and the distribution of blood flow to organs in circulatory shock. Postdoctoral fellows are accepted for one or two years of closely supervised research experience under the direction of a member of the staff. A few selected graduate students are prepared for a career in teaching and research in physiology and biophysics through recommended course work, participation in seminars, and closely supervised research leading toward the preparation of a satisfactory thesis. Adequate training in chemistry, physics, mathematics, and biology are prerequisites for graduate study. Graduate students with majors in other departments may elect physiology as a minor provided that they have obtained adequate background in general mammalian anatomy, neuroanatomy, and histology.

COURSE OFFERED

TOPICS IN BIOPHYSICS. Offered in the second trimester. In a series of weekly sessions of one to two hours, several areas where concepts derived from chemistry and physics have influenced biological thought will be reviewed and analyzed. The choice of topics will depend, in part, on the interests of the students. Previous topics have included: membrane physiology and biophysics, biological reaction rates, topics in irreversible thermodynamics. Where appropriate, demonstrations or laboratory exercises will be included. Prerequisites: Physics, physical chemistry, differential and integral calculus.

Public Health (Microbiology and Virology)

Chairman: Professor Walsh McDermott.

Professors: Walsh McDermott, Edwin D. Kilbourne.
Assistant Professors: Floyd M. Feldmann, Rene I. Jahiel, Jerome L. Schulman, Melvin S. Schwartz.

In this department of the Medical College a graduate degree (Ph.D.) may be obtained in certain of the medical sciences related to public health. Microbiology, with particular emphasis on virology and mycobacterial infections, is a field of special interest in the department. Advanced training and research are conducted in these areas and include studies of influenza virus genetics, experimental epidemiology, host determinants of viral virulence, and experimental chemotherapy. No formal courses of instruction are offered, but informal staff seminars in virology are held weekly. The University does not grant a Master's degree or a doctorate in public health.

DIVISION OF BIOMATHEMATICS

This Field is supported jointly by the Medical College and the Sloan-Kettering Division.

Biomathematics

Chairman: Professor Norman T. J. Bailey.

Professors: Norman T. J. Bailey, Sol I. Rubinow.
Visiting Professor: Hirsh G. Cohen.
Visiting Associate Professors: Betty J. Flehinger, Richard Kelisky.
Assistant Professor: Tai Te Wu.
Visiting Assistant Professor: Evelyn F. Keller.
Research Associate: Bruce W. Knight.

The Division of Biomathematics offers a wide range of opportunities for the development of quantitative methods in the biological and medical sciences, with special emphasis on the application of mathematics, probability, statistics, and automatic computers. Graduate study programs leading to advanced degrees are available to students whose primary interests are mathematical, but who wish to concentrate on biological or medical applications.

Graduate students will be expected to obtain a thorough training in applied mathematics, probability, statistics, and computational methods. In addition, appropriate courses of study in the relevant aspects of biology, chemistry, physics, and medicine will be planned to suit the particular area of application of the individual student. Typical research areas are biophysics, biological and chemical kinetics, epidemiology, genetics, molecular biology, numerical taxonomy, physiological systems, population growth and ecology, the planning of clinical trials, the storage and retrieval of medical information, surveillance programs, etc.

Special opportunities are also available for research at the postdoctoral level. While postdoctoral fellows should have a high degree of competence in the basic skills of biomathematics, they need not necessarily be professional mathematicians.

INTERDEPARTMENTAL COURSES

Advanced Graduate Biochemistry

A graduate course in biochemistry is offered jointly by the faculties of the Sloan-Kettering Division and the Medical College over a two-year period. In each trimester, 11 two-hour lectures are given at a rate of one a week. It is not essential that students take the course in any particular sequence. The course includes consideration at an advanced level of the following subjects, with particular attention to contributions of recent research: *1966-67*: Trimester 1, Enzymology; Trimester 2, Carbohydrates, Lipids, and Hormones; Trimester 3, Physical Methods in Biochemistry. *1967-68:* Trimester 1, Chemistry of Proteins; Trimester 2, Chemistry of Nucleic Acids; Trimester 3, Physical Methods in Biochemistry.

Biostatistics

Sponsored jointly by the Departments of Public Health and Pharmacology. In weekly meetings throughout the school year "least squares" theory, hypotheses testing with the conventional "t" test and chi-square procedures, analysis of variance, and probit analysis are considered. The course is designed to meet the needs of graduate students in the medical sciences in general, including those who wish to use epidemiologic technics in the conduct of research.

Genetics Seminar

An advanced seminar in genetics is offered each semester by the faculties of the Medical College and the Sloan-Kettering Division. The seminar consists of one two-hour session a week for four semesters in accordance with the following schedule: *Fall Semester, 1966*: Biochemical and Molecular Genetics. The biochemical nature of the hereditary material, recombination analysis of genetic fine structure, mechanisms of gene action in microorganisms. *Spring Semester, 1967*: Cytogenetics. DNA and chromosome duplication, mechanisms of gene action as related to chromosome structure, genetics of somatic cells. *Fall Semester, 1967*: Developmental Genetics. Gene action and the control of differentiation in higher organisms, sex determination, genetic control of metabolism. *Spring Semester, 1968*: Genetics of Man and Medical Genetics. Populations and families, statistical methods and study design in human genetics, study of human variation, clinical genetics.

Six or more university-credit hours in genetics, or attendance at the lectures pertaining to genetics given in the Department of Anatomy, and the instructor's permission are required for admission. Two semesters are required for a minor in genetics, and all four semesters are required for a major in genetics.

INSTRUCTION AT THE SLOAN-KETTERING DIVISION

Frank L. Horsfall, Jr., Director
Liebe F. Cavalieri, Associate Director

GENERAL PLAN. The program is designed to meet the individual needs of the student. There is no particular set of lecture or laboratory courses for any given area. The instructional program of one candidate does not necessarily bear any relationship to the program of another candidate registered for the same subject. It is up to the student to decide first on a general area of interest for his major subject and then to discuss the program with one or several professors who may serve as sponsors.

Listed below are some of the specialized lecture and seminar courses offered in the Division.

GRADUATE SEMINAR. The weekly graduate seminar is offered each year and is attended by all graduate students of the Division. The sub-

jects covered vary from year to year, but in general they deal with problems of modern biology. Two or three topics are selected for discussion each year, and an attempt is made to rotate the subjects on a three-year cycle. Topics are usually chosen from the following: nucleic acid and protein chemistry and biochemistry; chromosome structure and function; special topics in bacterial genetics; regulation; radiobiology; mammalian and bacterial viruses. The discussion is carried principally by graduate students under the guidance of faculty members whose area of specialization coincides with the topic. From time to time outstanding authorities in the field are invited as guest speakers.

SPECIAL TOPICS COURSE. The Special Topics course covers subjects similar to those of the Graduate Seminar and consists of lectures given by faculty members or guest lecturers, or both. The subject matter varies from year to year. A student is expected to take this course for two years and to audit it during the remaining years, as he will be responsible for the material in Final Examination A.

Biochemistry

Chairman: Professor Martin Sonenberg.

Professors: M. Earl Balis, Aaron Bendich, Oscar Bodansky, George B. Brown, Liebe F. Cavalieri, Jack J. Fox, Mary L. Petermann, C. Chester Stock.

Associate Professors: Ralph K. Barclay, Saul Green, Morton K. Schwartz, Martin Sonenberg.

Assistant Professors: Ellen Borenfreund, John F. Codington, Alfredo Giner-Sorolla, Mary G. Hamilton, Dietrich Hoffmann, Willi Kreis, Jerome S. Nisselbaum, Barbara H. Rosenberg, Josephine S. Salser, Vladimir P. Skipski, Archie L. Smith.

Opportunities are available for advanced work and research in chemistry and metabolism, bio-organic chemistry, enzymology, hormone chemistry and action, and molecular biology.

Undergraduate requirements for a major in biochemistry include courses in inorganic chemistry, qualitative chemistry, quantitative chemistry, organic chemistry, physical chemistry, physics (mechanics, electricity, and magnetism, and sound, heat, light), biochemistry and mathematics (through calculus). If any of these requirements are not completed at the undergraduate level, they must be completed at the onset of graduate study. Furthermore, while the Graduate Record Examination is not generally required of applicants, those applicants who are not within the top third of their graduating class are urged strongly to support their applications with scores attained on the Graduate Record Examination in both the Aptitude Test (Verbal and Quantitative) and the Advanced Test in Chemistry.

Students electing biochemistry as a major or minor subject must complete the Medical College course in biochemistry, or its equivalent, as a minimum requirement.

In addition, students who major in biochemistry must complete five trimesters, and those who minor, three trimesters, of the course Advanced Graduate Biochemistry.

COURSES OFFERED

ADVANCED GRADUATE BIOCHEMISTRY. The course and the hours when it is given are described on page 34 under Interdepartmental Courses.

Biology

Chairman: Professor Frederick S. Philips.

Professors: Frank W. Foote, Jr. (Pathology), Frank L. Horsfall, Jr. (Microbiology), Frederick S. Philips (Pharmacology).

Associate Professors: Edward A. Boyse, Etienne de Harven, Jørgen E. Fogh (Microbiology), Charlotte Friend (Microbiology), Peter J. Gomatos (Microbiology), Dorris J. Hutchison (Microbiology), Leopold G. Koss (Pathology), Alice E. Moore, Lloyd J. Old, H. Christine Reilly (Microbiology), Stephen S. Sternberg (Pathology), Leo Wade (Preventive Medicine), Ernest L. Wynder (Preventive Medicine).

Assistant Professors: June L. Biedler, Edward S. Essner, Wilbur F. Noyes III, Herbert F. Oettgen, Herbert S. Schwartz (Pharmacology), Francis M. Sirotnak (Microbiology), Bernard Tandler, Morris N. Teller.

Instructors: Alberta M. Albrecht, James G. Cappuccino, Elaine G. Diacumakos, George Sichuk.

The program in biology is oriented toward an understanding of factors which initiate, control, and modify growth and biological development. Opportunity is offered for advanced work and research in cytology, genetics, virology, immunology, microbiology, endocrinology, and pharmacology.

Undergraduate prerequisites for a major in biology include courses in inorganic chemistry, organic chemistry, qualitative and quantitative chemistry, physical chemistry, physics (mechanics, electricity, and magnetism; sound, heat, and light), mathematics (through calculus), and general biology or zoology or botany. If any of these requirements are not completed at the undergraduate level, they must be completed during the first year of graduate study.

Programs are determined individually on the basis of interest, training, and prior experience. Elective courses in basic medical sciences include those described for the Medical College. The Division offers a general cytology course which is currently given in alternate years (next offered in 1967-68) and consists of lectures on light and electron microscopy, cell theory and fine structure, cytopathology, and cancer cell and tissue culture cytology. Formal graduate courses, seminars, and tutorials will be arranged with the faculties of the Sloan-Kettering Division and the Medical College and will include courses in cell physiology and methods in biological research.

Biophysics

Chairman: Professor Edward R. Epp.

Professor: John S. Laughlin.
Associate Professors: Edward R. Epp, Helen Q. Woodard.
Assistant Professors: Karin R. Corey, Harold Moroson, Ira Pullman, Louis Zeitz.
Instructors: Jerrold Fried, Peter J. Kenny, Jae Ho Kim.

Graduate work is offered leading to the Ph.D. degree in biophysics and the M.S. in radiation physics.

Undergraduate prerequisites include courses in general physics, electricity and magnetism, mechanics, mathematics (through calculus), and thermodynamics, and acceptable laboratory experience in these fields. If any of these requirements are not completed at the undergraduate level, they must be completed at the onset of graduate study.

Some of the research projects in biophysics which are pertinent to the Ph.D. program include: studies of the metabolism of various isotope-labeled compounds in man; metabolism of biologically important compounds in tissue cultures of human tumor cells, in bacteria, and in viruses; the mechanism of radiation action on bacteria, phage, yeast, and small animals, including metabolic studies with human and other tumors influenced by radiation under different environmental conditions; fundamental radio-biological studies of mammalian cells in tissue culture, using synchronized cell populations and metabolic inhibitors; trace element analysis of tissue sections by means of fluorescent X-ray spectrometers; electron spin resonance spectroscopy of free radicals in carcinogenic and irradiated compounds; study of the early radiation-induced processes in cells using high-intensity pulsed irradiation techniques; the investigation, using existing computer facilities, of mathematical models which simulate the behavior of biological systems, e.g., the proliferation of cells in human leukemia, the measurement of radiation by calorimetric, chemical, and solid-state techniques.

The course of study leading to the M.S. degree in radiation physics trains physicists in the various aspects of production, measurement, and application of radiation to various medical and biological problems. These problems particularly involve the use of radiation in the diagnosis and treatment of cancer. A variety of radiation sources are available, capable of generating photons and electrons with energies ranging from 5 Kev to 25 Mev and with electron dose-rates up to 10^{14} rads per second. Experience is also provided in the handling and use of many different radioisotopes. The magnitude and variety of facilities and unique radiation projects at the Sloan-Kettering Institute and the Memorial Hospital are particularly pertinent for training in this area. An important feature is the co-existence of fundamental research and practical and clinical applications in the same center.

COURSES OFFERED

1. RADIOLOGICAL PHYSICS. Lecture and problems. A series of hourly lectures and assigned problems in applied mathematics, funda-

mentals of radiation physics, X-ray and radium treatment planning, diagnostic X-ray principles, radiation protection, and uses of radioactive isotopes.

2. RADIATION BIOPHYSICS. A full-year course covering the fundamentals of radiation physics, radiation chemistry, and radiation biology.

3. ADVANCED BIOPHYSICS. Laboratory courses in each of the topics of radiation biophysics.

4. BIOPHYSICS COLLOQUIA. Reports on research in progress by faculty and outside lecturers; required for majors in biophysics.

REGISTER OF STUDENTS

DOCTORS OF PHILOSOPHY

Loretta Chiuh-Yeou Cheong, B.S. 1948, University of the Philippines; M.S. 1951, University of Michigan; Ph.D. 1966, Cornell University. Major: Biochemistry. Manila, P.I.

Roland Alan Finston, A.B.-B.S. 1957, University of Chicago; M.S. 1959, Vanderbilt University; Ph.D. 1965, Cornell University. Major: Biophysics. Chicago, Ill.

Hanspaul Hagenmaier, Diplomchemiker 1961, Universitaet Tuebingen; Ph.D. 1965, Cornell University. Major: Biochemistry. Geislingen/St., Germany

Frank Eugene Lilly, B.S. 1951, West Virginia University College of Pharmacy; Ph.D. 1965, Cornell University. Major: Pharmacology. New York, N.Y.

Paul Milvy, A.B. 1953; M.S. 1962; Ph.D. 1966, Cornell University. Major: Biophysics. New York, N.Y.

Arthur Raines, B.S. 1957, Fordham University College of Pharmacy; M.S. 1960, Columbia University College of Pharmacy; Ph.D. 1965, Cornell University. Major: Pharmacology. Jackson Heights, N.Y.

Chull Sung Song, A.B. 1957, Birmingham-Southern College; M.D. 1960, Columbia University; Ph.D. 1966, Cornell University. Major: Biochemistry. New York, N.Y.

Elliott H. Stonehill, B.S. 1950, The College of the City of New York; M.A. 1956, Brooklyn College; Ph.D. 1965, Cornell University. Major: Biochemistry. Mt. Vernon, N.Y.

John David Termine, B.S. 1960, St. John's University; M.S. 1963, University of Maryland; Ph.D. 1966, Cornell University. Major: Biochemistry. Brooklyn, N.Y.

Susan S. Wallace, B.S. 1959, Marymount College; M.S. 1961, University of California; Ph.D. 1965, Cornell University. Major: Biophysics. Brooklyn, N.Y.

MASTER OF SCIENCE

Marian W. Blackwell, B.S. 1963; M.S. 1966, Cornell University. Major: Anatomy. Lexington, Kentucky

CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Lorraine S. Abrash, A.B. 1955, Cornell University. Major: Biochemistry. West Englewood, N.J.

Meryl S. Atlas, B.S. 1960, The College of the City of New York. Major: Biochemistry. New York, N.Y.

Fran Auerbach, B.S. 1965, Cornell University. Major: Microbiology. Huntington Station, N.Y.

Roberta M. Bruck, B.A. 1957, Douglass College; M.A. 1962, Columbia University. Major: Anatomy. Highland Park, N.J.

Gary Citrin, B.S. 1963, Brooklyn College of Pharmacy. Major: Pharmacology. Brooklyn, N.Y.

Aristides Costeas, B.Sc. 1958, University of Athens; M.A. 1964, Columbia University. Major: Biophysics. Elmhurst, N.Y.

Robert A. Erlandson, B.A. 1959, New York University; M.S. 1963, Long Island University. Major: Cytology. Woodside, N.Y.

Anastasia Gregoriades, B.A. 1962; M.A. 1964, Hunter College. Major: Biology. New York, N.Y.

Edwin C. Hahn, B.A. 1958, Amherst College. Major: Microbiology. Scarsdale, N.Y.

June E. Kaiser, B.S. 1965, Cornell University. Major: Microbiology. Locust Valley, N.Y.

Harriet R. Levie, A.B. 1960, Barnard College; M.A. 1964, Hunter College. Major: Biochemistry. New York, N.Y.

Gesina L. Longenecker, B.S. 1965, Newcomb College. Major: Pharmacology. New Orleans, La.

Stephen Margolis, B.A. 1963, Yeshiva University. Major: Biology. New York, N.Y.

Anne G. Mazelis, B.S. 1962, The College of the City of New York; M.S. 1964, University of Chicago. Major: Biochemistry. New York, N.Y.

Jo Anne Munigle, B.A. 1957, Connecticut College. Major: Anatomy. West Hartford, Conn.

Melvyn J. Myers, B.Sc. and A.R.C.S. 1960, Imperial College of Science (London). Major: Biophysics. New York, N.Y.

Arthur Myles, B.A. 1960, Middlebury College; M.A. 1962, Wesleyan University. Major: Biochemistry. Yonkers, N.Y.

Margaret R. Payne, B.S. 1964, Medical College of Virginia College of Pharmacy. Major: Biochemistry. Richmond, Va.

Charles S. Rubin, B.S. 1965, University of Scranton. Major: Biochemistry. Scranton, Pa.

Priscilla A. Schaffer, B.S. 1964, William Smith College. Major: Microbiology. Erie, Pa.

Irene A. Skipski, A.B. 1955, Temple University. Major: Biochemistry. New York, N.Y.

David Soifer, B.S. 1961, Columbia University. Major: Anatomy. New York, N.Y.

Lloyd M. Stempel, B.S. 1956, The College of the City of New York. Major: Biochemistry. Brooklyn, N.Y.

Elizabeth B. Thompson, B.A. 1964, Radcliffe College. Major: Anatomy. Newark, N.J.

Barbara K. Urbaitis, B.A. 1960, Hunter College. Major: Physiology. New York, N.Y.

Arnoldo K. Ventura, B.Sc. 1961, University College of the West Indies. Major: Microbiology. Jamaica, B.W.I.

Ramah Weisblum, B.A. 1959, Barnard College; M.S. 1964, New York University. Major: Biology. New York, N.Y.

Sarah S. Winans, A.B. 1963, Cornell University. Major: Anatomy. Murray Hill, N.J.

Marion M. Zatz, A.B. 1965, Barnard College. Major: Microbiology. New York, N.Y.

CANDIDATES FOR THE DEGREE OF MASTER OF SCIENCE

Anna B. Drakontides, B.A.; 1955, M.A. 1960, Hunter College. Major: Anatomy. New York, N.Y.

John W. Henke, Jr., B.S. 1963, Eastern Michigan University. Major: Radiological Physics. East Detroit, Mich.

César Wong-Chia, M.D. 1958, National University of Mexico. Major: Microbiology. Ciudad Universitaria, Mexico

STUDENTS ENTERING IN SEPTEMBER, 1966

Leonard A. Cohen, B.S. 1960, University of Wisconsin. Major: Biochemistry. Forest Hills, N.Y.

Joseph DiSalvo, B.A. 1966, New York University. Major: Physiology. Brooklyn, N.Y.

Augustus C. Damian, A.A. 1958, Silliman University; M.D. 1963, University of the Philippines. Major: Physiology. Quezon City, P.I.

William G. Hunt, B.S. 1966, Union College. Major: Pharmacology. Torrington, Conn.

Ronald Joseph, B.S. 1963, Tufts University; M.S. 1965, University of Massachusetts. Major: Microbiology. Hull, Massachusetts

Stanley E. Kapuchinski, Jr., B.A. 1966, Fordham University. Major: Anatomy. Newington, Conn.

Irving A. Lerch, B.S. 1960, United States Military Academy; M.S. 1966, University of Chicago. Major: Biophysics. Chicago, Ill.

Neal A. Machtiger, B.S. 1966, Cornell University. Major: Microbiology. Valley Stream, N.Y.

Jeanne I. Rader, B.A. 1966, Syracuse University. Major: Biology. Hamburg, N.Y.

Index